

A review of recent knowledge on White-tailed Eagles in Croatia

Tibor MIKUSKA

Abstract: This paper reviews the recent knowledge on the White-tailed Eagle *Haliaeetus albicilla* in Croatia. Data on distribution, population size, breeding success, wintering, habitat requirements, feeding biology, color ringing programs, threats, birds in captivity and protection status are given. The Croatian population continually increased and was estimated at 135–145 pairs in 2006. The annual breeding success was estimated at 70.8–84.6% during 2005–2006, thus the population was considered healthy and viable. The intensification of forest management, river regulation and drainage projects, abandonment of fishponds and poisoning were pointed to as the major threats. The continuation and expansion of the National Monitoring Program as well as studies on pollutants will be highly necessary in the future.

Key words: *Haliaeetus albicilla*, breeding, wintering, habitat, color ringing, threats, protection, White-tailed Eagle, Croatia.

Introduction

The White-tailed Eagle is a regular breeding bird in Croatia (KRALJ 1997, LUKAČ 2007). The purpose of this paper is to give a review on the recent knowledge of the White-tailed Eagle population in Croatia.

Distribution

The White-tailed Eagle is distributed in the northern Pannonian lowland and continental parts of Croatia that are bordered by the rivers Mura and Drava to the north, and Kupa and Sava to the south (RADOVIĆ et al. 2003, RADOVIĆ & MIKUSKA 2009, fig. 1). Breeding data from the Pannonian Plain exist from the end of the 19th century (FRIVALDSKY 1891, MOJSISOVICS 1886). Observations (primarily data on shot individuals) of White-tailed Eagles in the Mediterranean region date back to the end of the 19th century (KOLOMBAT-TOVIĆ 1880, 1896, WASHINGTON 1885) and eagles were breeding on the Island of Cres at the beginning of the 20th century until the end of the 1920s (DEPOLI 1928) and in the Delta of the Neretva River (in the Hutovo blato, today Bosnia and Herzegovina) until the end of the 1940s (RUCNER 1954, 1998). Nowadays these small, isolated populations in the Mediterranean part of Croatia are extinct (RADOVIĆ et al. 2003).

Population size and breeding success

Similar to other countries, the White-tailed Eagle population was at its lowest during the 1970s due to

persecution and pesticide pollution. Only 11 pairs were breeding in the Kopački Rit wetlands in 1976 (MIKUSKA 1979) and 15 pairs in 1980 (MIKUSKA & MIKUSKA 1980) compared to 20 pairs in 1878 and 1885 (RUDOLF VON ÖSTERREICHCH et al. 1879, MOJSISOVICS 1886) or 19 pairs in 1943 (HOMONNAY 1944). There are no data on the nationwide population size, though.

During the late 1980s, research on the White-tailed Eagle was initiated at the Kopački Rit and Lonjsko Polje wetlands, as well as along the lower Sava River. Based on this, the national population was assessed at 60–70 breeding pairs (KRALJ 1997, RADOVIĆ & SUŠIĆ 1997) and, at the end of the 20th century, at 70–80 pairs (SCHNEIDER-JACOBY et al. 2003). The population continued to grow and increased up to 80–90 pairs in the year 2000 (RADOVIĆ et al. 2003, HELANDER & STJENBERG 2003, BIRDLIFE INTERNATIONAL 2004), 120–130 in 2005 (RADOVIĆ et al. 2005) while today (data from 2006) the population is estimated to hold at least 135–145 pairs (RADOVIĆ & MIKUSKA 2009). It is assumed that Croatia supports the largest population of all neighboring Central European countries and at least 1.9–2.0% of the total European population which is estimated at 7,000 pairs (HELANDER & STJENBERG 2003, BIRDLIFE INTERNATIONAL 2004).

The most important breeding sites are given in tab. 1 (after RADOVIĆ & MIKUSKA 2009). More than 51% of the national White-tailed Eagle population breed in two large protected sites (the Kopački Rit and Lonjsko Polje Nature Parks, fig. 1) suggesting the importance of protected areas for the long-term survival of this

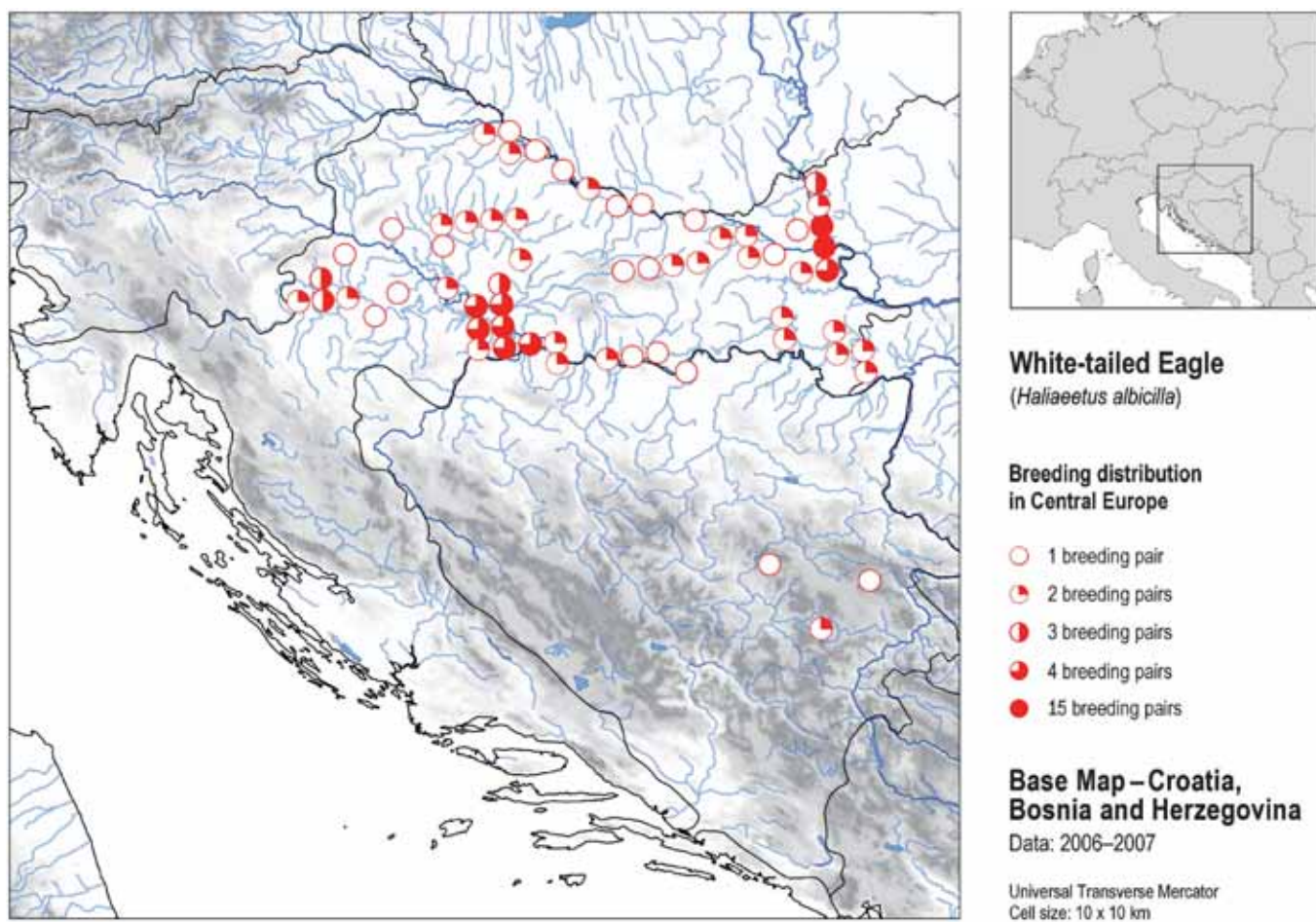


Fig. 1: Breeding distribution of the White-tailed Eagle in Croatia 2006–2007. — Brutverbreitung des Seeadlers in Kroatien 2006–2007.

Brood size of White-tailed eagles in Kopacki rit

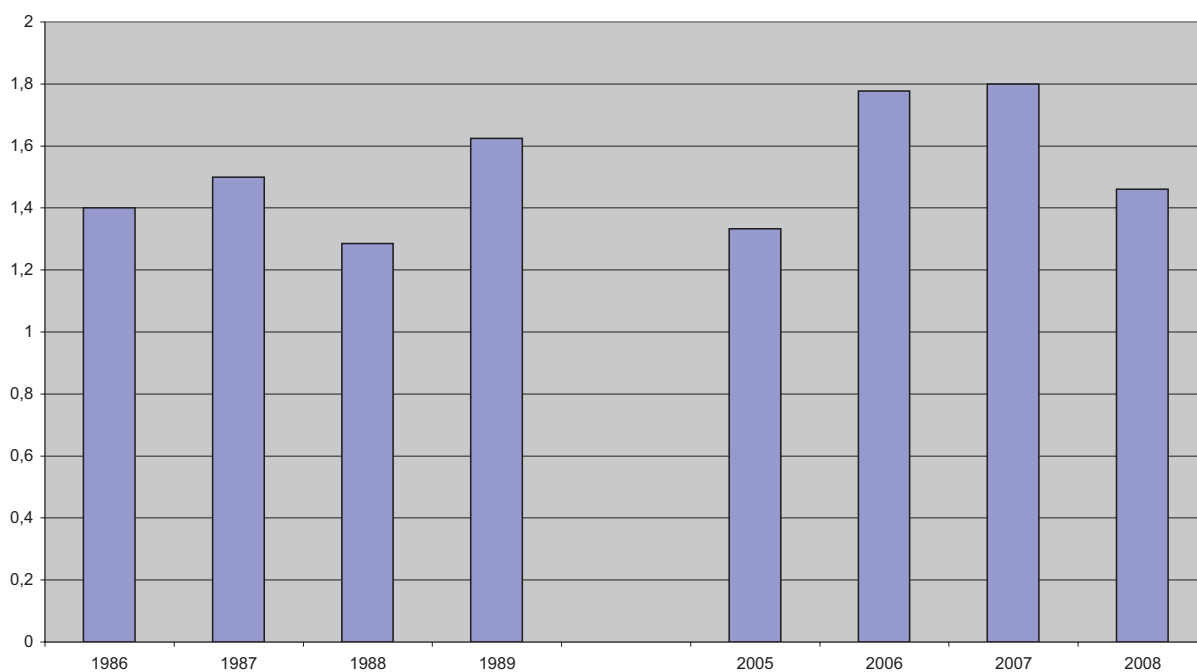


Fig. 2: Brood size of White-tailed Eagles in Croatia. — Brutgröße von Seeadlern in Kroatien.



Fig. 3: A White-tailed Eagle brood with three chicks.
Photo: L. Lukacs — Eine Seeadlerbrut mit drei Jungvögeln.

species. Kopački Rit Nature Park is situated in the north-eastern part of Croatia where the Drava River joins the Danube. Kopački Rit is part of the extensive Danube River floodplains that extend to the neighboring countries of Hungary and Serbia. Lonjsko polje Nature Park is situated in central Croatia along the Sava River and is part of the more than 120.000 hectares large extensive Sava River floodplains.

The annual breeding success (pairs rearing young) was recently estimated for four sites in Croatia (the alluvial wetlands of the Danube River and Kopački rit, the alluvial wetlands of the Sava River and Lonjsko polje, Spačva forest, as well as the alluvial forests along the rivers Ilova and Lonja), and ranged from 70,8–84,6% (RADOVIĆ & MIKUSKA 2009). This is in accordance with literature data from other parts of Europe (HELANDER & STJENBERG 2003) suggesting that the Croatian population is healthy and viable at the moment. There were no statistical differences in the annual breeding success between protected and unprotected areas (RADOVIĆ & MIKUSKA 2009).

Data on brood size (number of chicks per successful nest) exist for two periods: 1986–1991 for the larger part of Pannonian Croatia (including the regions Pokupje, Posavina, Podravina and Podunavlje), while for the period 2005–2008, the data cover only the Kopački Rit wetlands. Brood size was assessed by direct nest inspections in the course of colour-ringing (tab. 2). Breeding

Table 1: The most important breeding areas of White-tailed Eagles in Croatia during 2006 (after Radović & Mikuska 2009). — *Die bedeutendsten Brutgebiete des Seeadlers in Kroatien im Jahr 2006.*

Area	No. of breeding pairs
1 Alluvial wetlands of the Danube river (incl. Kopački Rit Nature Park)	42–45
2 Alluvial wetlands of the Sava River (incl. Lonjsko Polje Nature Park)	28–30
3 Alluvial forests along Ilova and Lonja Rivers with adjacent fishponds	20–25
4 Alluvial forests along lower Sava River (incl. Spačva forests)	10–15
5 Pokupsko depression	10–12
6 Alluvial forests of the Drava River in Slavonia (from Slatina to Koška)	6–8
7 Alluvial forests of the lower Drava River	5–10
Total	121–145

Table 2: Breeding parameters of White-tailed Eagles in Croatia (note: data from 2005–2008 refers to Kopački Rit Nature Park only). — *Brutparameter des Seeadlers in Kroatien (Daten aus den Jahren 2005–2008 beziehen sich ausschließlich auf den Naturpark Kopački Rit).*

Year	No. of nests	Total chicks	Average brood size	Source
1986	8	11	1,38	I. Ham unpubl.
1987	19	27	1,42	I. Ham unpubl.
1988	22	27	1,23	I. Ham unpubl.
1989	17	28	1,65	I. Ham unpubl.
1990	17	29	1,70	I. Ham unpubl.
1991	6	11	1,83	I. Ham unpubl.
2005	9	12	1,33	MOROZ ET AL. 2008
2006	18	32	1,78	MOROZ ET AL. 2008
2007	19	34	1,79	MOROZ ET AL. 2008
2008	13	19	1,46	T. Mikuska unpubl.
Total	148	230	1,55	

Fig. 4: The Kopački rit Nature Park is the most important breeding site of White-tailed Eagles in Croatia.
Photo: T. Mikuska — Der Naturpark Kopački rit ist das bedeutendste Brutgebiet des Seeadlers in Kroatien.



success ranged from 1,23–1,83 chicks/successful pair during 1986–1991 (I. Ham unpubl.), and from 1,33–1,79 chicks/successful pair during the 2005–2008 period (MÓROČZ et al. 2008, T. Mikuska et al. unpubl.), respectively (fig. 2). These data are in accordance with literature data from other parts of Europe (HELANDER & STJENBERG 2003, HORVÁTH & PINTER 2005). Brood size ranged from one to three chicks per nest. Nests with three chicks were recorded in 2001, 2006 and 2007 (fig. 3). During the 1986–1991 ringing period, nests ($n = 89$)

with one young were recorded in 51% of cases, with 2 chicks in 48% and with 3 chicks in 1% of all cases (I. Ham unpubl.). During the 2005–2008 period, nests ($n = 59$) with one young were recorded in 39% of cases, with 2 in 57% and with 3 chicks occurred in 3% of all cases (MÓROČZ et al. 2008, T. Mikuska et al. unpubl.).

Winter population size

The winter population of the White-tailed Eagle in Croatia is estimated to range from 400+ (HELANDER & STJENBERG 2003) to 501–1.000 individuals (LUKAČ 2007). This estimate is based on the assumption that all adult birds are territorial throughout the year along with a certain number of immature birds that could be found in the region. However, these numbers are only partly supported by the actual results from the mid-winter waterbird censuses. For example, in the Kopački Rit wetlands, 40–98 eagles were counted during the 2002–2008 period (T. Mikuska unpubl.), and at Lonjsko Polje Nature Park 23–58 eagles were counted during 2003–2008, respectively (V. Hima unpubl.).

Habitat requirements

As in the whole of the Pannonian Plain, White-tailed Eagles in Croatia depend on freshwater habitats and wetlands with a sufficient prey base and large mature trees that can support their huge nests. The highest



Fig. 5: A White-tailed Eagle with "Hungarian" color rings which were used in the period 2005–2007. Photo: A. Morocz — Ein Seeadler mit "ungarischen" Farbringen, die im Zeitraum 2005–2007 verwendet wurden.

breeding densities are concentrated in the large yet intact floodplains of the rivers Danube (fig. 4) and Sava (RADOVIĆ & MIKUSKA 2009, SCHNEIDER-JACOBY et al. 2003, SCHNEIDER-JACOBY 1996).

During the 2003–2006 period, 50% of the Croatian breeding population were situated within a 2 km radius from the nearest large water bodies (large rivers, marshes, oxbows or cyprinid fishponds larger than 8 ha), and 90% of the breeding population were situated within 4 km of large water bodies (A. Radović unpubl.). Nests ($n = 109$) were built 15–860 m from the nearest water body (including temporary ponds) available for feeding (mean \pm SE = $265 \pm 20,5$; A. Radović unpubl.).

Nests were built on eight tree species (in descending order of frequency): Pedunculate Oak (*Quercus robur*), Narrow-leaved Ash (*Fraxinus angustifolia*), Black Poplar (*Populus nigra*), White Poplar (*P. alba*), White Willow (*Salix alba*), Sessile Oak (*Q. petraea*), euro-american poplar hybrids (*Populus* sp.) and Beech (*Fagus sylvatica*; RADOVIĆ & MIKUSKA 2009, A. Radović unpubl.). However, it should be noted that the selected tree species is related to the overall availability of forest communities in the given area. For example, in the Kopački Rit Nature Park more than two-thirds of the nests are built on White Willows and Black Poplars as a result of the availability and predominance of these two forest communities (T. Mikuska unpubl.).

The trees that are selected for nest-building are large, mature trees, well beyond the rotation period. The preference for trees with diameters $>92,5$ cm (circumference >290 cm) was greater than for trees with diameters ranging from 67,6 to 92,5 cm ($C = 210$ – 290 cm, RADOVIĆ & MIKUSKA 2009).

Like other large raptors, White-tailed Eagles are sensitive to disturbance at the nest and they require ar-

eas of low human activity (HELANDER & STJENBERG 2003). RADOVIĆ & MIKUSKA (2009) assessed the distances from active nests to the nearest roads. Distances to the nearest highway or county road ranged from 30–5.690 m ($n = 109$, mean \pm SE = $1.304 \pm 116,8$ m), distances to other local or forestry roads ranged from 40–2.950 m ($n = 109$, mean \pm SE = $610,2 \pm 54,4$). Distances between active nests to the nearest human settlement ranged from 425–7.500 meters ($n = 109$, mean \pm SE = 2.742 ± 139) with the majority of nests situated 1–2 km from settlements.

National and International Color Ringing Programs

From 1985–1988, a marking scheme which included the application of patagial wing tags, was established in former Yugoslavia, including Croatia (HAM et al. 1988, 1990). During that period, a total of 90 nestlings were ringed of which 87 were additionally wing-tagged. Out of that number, 54 nestlings were ringed at the Kopački Rit wetlands (I. Ham & J. Mikuska unpubl.). Until 1989, 330 sightings and five recoveries of marked eagles were reported, with a 72,4% sighting rate. Immature birds were observed up to 178 km from the marking place within the Pannonian plain countries (Croatia, Hungary and Serbia). The Kopački Rit wetlands were the main staging site because all but five birds were observed there at least once (J. Mikuska, pers. comm.). 72,2% of all recoveries were 1-year old birds, 23,1% were 2-years old and 4,7% were 3-years old birds (HAM et al. 1990). The project was abruptly terminated in 1991, as well as all observations at the Kopački Rit wetlands, due to the outbreak of the war. After the cessation of hostile activities, the monitoring of the White-tailed Eagle population was re-commenced in 1997. However, none of the previously marked birds were ever



Fig. 6: Forest fragmentations along the (a) river Drava and (b) the river Sava. <http://Earth.google.com> — Waldfragmentierungen an (a) der Drau bzw. (b) der Save.



Fig. 7: The extraction of sand from the riverbed (Drava near Petrijevci) is part of the river regulation project and causes severe disturbance to breeding eagles. Photo: I. D. Grlica — Die Entnahme von Sand aus dem Flußbett wie hier an der Drau bei Petrijevci ist Teil des Flussregulationsprojektes und verursacht eine massive Störung brütender Seeadler.

seen, indicating the problem of the quality of wing tags with respect to their durability (HAM et al. 1990).

A new color marking scheme, this time partly under the International Sea Eagle Color Ringing Programme, was initiated at Kopački Rit, under the Agreement of co-operation between the Kopački Rit Nature Park Management Office and the Danube-Drava National Park Directorate (MÓROCZ et al. 2008). Until 2008, 62 nestlings were ringed in total, including 47 with additional color rings. From 2005–2007 color rings were from the “Hungarian” cohort of the International Sea Eagle Color Ringing Programme (fig. 5), and during 2008, white plastic rings with black inscriptions were used. From 2009 onwards, Croatia will participate regularly in the International Sea Eagle Color Ringing Programme with appropriate rings (HELANDER 1985).

Threats

The existing White-tailed Eagle population in Croatia is threatened by typical hazards as defined by HELANDER & STJENBERG (2003). The following threatening factors have been recorded so far:

Intensification of forest management – Alluvial forests in Croatia are managed in a way that, for the purpose of maximizing the use of equipment and machines, forest stands are even-aged (all the trees of the dominant species are of similar age). By that, the whole forest stand (up to several hundred hectares) are clear-cut at the same time causing severe fragmentation in the usually homogenous forest cover (fig. 6). This practice causes a reduction in the availability of suitable trees for nesting. Coupled with the short rotation period for soft-

wood tree species, which is set at 30 years for *Populus* and *Salix* and too short for the development of large and mature trees that can support an eagle’s nest, the intensification of forestry could have an increasingly negative impact on the White-tailed Eagle population in Croatia in the near future. In non-protected areas, mature stands of hardwood tree species are sometimes replaced by fast-growing softwood plantations, a forestry practice that may prevent any possibility for the eagles’ breeding in a long, 60–90 years timeframe (as it would take 30 years for the plantation to reach the rotation period and another 30–60 years after the clear-cut for the restored forest to develop trees suitable for eagle nests).

Building new forest roads, usually for the easier exploitation of the forest, increases access into the forest causing additional disturbance to breeding pairs.

At the moment, the intensification of forest management is ranked “medium”, but in the near future (the next 20 years), as old and mature stands would come up to harvesting age, the potential threat could have a high impact on the national breeding population.

River regulation and drainage projects – The Croatian breeding population is facing severe threats from the recent river regulation projects on the rivers Sava and Drava, as well as intensive drainage schemes that are applied within the former floodplain boundaries. Extensive river regulation projects are proposed by the authorities for navigation and hydro-electric dams (SCHNEIDER-JACOBY 2002, 2005). If carried out, these plans would cause river bed degradation, disconnection of the floodplains from the rivers and alluvial forest degradation. As a consequence, the White-tailed Eagle population would face decreased feeding and breeding possibilities. Intensive drainage projects being carried out in the former floodplain areas are already causing the degradation of small temporary wetlands and oxbows.

The river regulation projects include so called “maintenance” of the navigation corridor and extraction of gravel and sand from the riverbed for commercial purposes (fig. 7). These activities cause severe disturbance to the eagles breeding on the otherwise remote river islands. For example, out of five pairs breeding at the middle Drava River during 2006, three had disappeared due to river regulation works and gravel extraction by 2008 (I. Grlica, pers. comm.).

Abandonment of fishpond production – An important part of the Croatian population depends on the extensively managed warm-water cyprinid fishponds (RADOVIĆ & MIKUSKA 2009). During the past decade, fish production on many of the existing fishponds was severely decreased (up to 50% of the surface area) or completely abandoned (e.g. Podunavlje, Lipovljani,

Sloboština, Pissarovina, or Draganići fishponds). The importance of closing commercial fish-ponds and reductions in the prey base is ranked “high” in Croatia (HELANDER & STJENBERG 2003).

Disturbance of nests by hunting, tourism and recreation – At the present time, apart from the national parks, most of the land including protected sites like special zoological reserves (IUCN category I) are regarded as hunting grounds. Under the recent Croatian legislation the hunting season is year-round for some game species (e.g. Wild Boars *Sus scrofa*) and it is associated with the intensive feeding of game animals and the intensification of hunting activities (including building hunting facilities near active nests). The year-round movements of hunters in areas close to the eagles’ nests causes disturbance, nesting failures and abandonment of nesting sites. For example, breeding failures and cases of territory abandonment are higher with pairs in Kopački Rit that were nesting in the former floodplain (where visits to the area are not obstructed by regular floods) than in the remote parts of the still functioning floodplain (T. Mikuska unpubl.).

Tourism and recreational activities, particularly fishing and hiking through natural habitats, are considered to have a “low” impact on the breeding population at the moment. However, with the development of tourism activities in the existing Nature Parks, without proper visitor management, the issue could become increasingly important.

Poisoning and secondary poisoning from lead ammunition – Although there are no empirical data on lead poisoning within the White-tailed Eagle population in Croatia, this threat is very likely (comp. KRONE et al., this volume). Lead ammunition is not outlawed by the current Hunting Laws and is commonly used in all hunting grounds, including wetland sites such as fishponds and floodplains. Waterfowl hunting at fishponds by foreign hunters is particularly important due to the well-known fact of acute and chronic lead poisoning of waterfowl and the subsequent feeding of eagles on such sick or dead birds. This threat level should be regarded as “high” on the national scale.

Illegal killing, nest robbery and trade – Despite the positive changes in attitude of the local population towards nature protection and large raptors, White-tailed Eagles in Croatia are still shot (and presumably also killed). The number of such cases is small and possibly insignificant regarding the whole national population, but it is worth mentioning such cases as a warning sign. For example, an adult eagle was found injured at the Busiklica forest in the Baranya region in January 2008. The bird was transferred to the AWAP rescue centre



Fig. 8: Satellite picture of the Petres-Mentes area. Fragmentation of the forest is result of hydromorphological processes. Linear, small forest stripes host eagle nests as well as major forest roads, causing substantial disturbance. <http://Earth.google.com> — In Überschwemmungsgebieten sind Wälder oft linear und von geringer Ausdehnung. Dort werden die Seeadlernester angelegt, führen aber auch die Forstwege durch. Dies führt zu gravierenden Störungen.

where lead shot was found during an X-ray examination. Since then, this bird is under veterinary treatment (I. Bata & T. Mikuska unpubl.).

To the best of my knowledge, robbery of eagle nests has not been reported within the last decade. Since the nests are built at heights of 25–35 meters, nest robbing would require specific alpinist skills and additional logistical support. On the other hand, records of taking inexperienced chicks at the time of their first flight are recorded. In the past, such birds ended up in private collections (BATA et al. 2007). Under the recent Nature Protection Act, it is illegal to possess strictly protected species without proper documentation and such birds are now confiscated by governmental officials and placed in rescue centers. However, nest robbery and illegal killing are potentially regarded of “high” importance in Central and Southern Europe (HELANDER & STJENBERG 2003).

Secondary poisoning from pesticides and pollutants – There are very few data about secondary poisoning from pesticide and pollutants in the literature (HAM et al. 1988, SPIRIĆ et al. 1988) where high concentrations of mercury and PCBs were found in the eagles’ feathers and eggs. However, during the winter of 2007/2008, we were witnesses of the severe mortality of Roe Deer *Capreolus capreolus* due to the inappropriate use of rodenticides on the fields (over 20 animals were found dead on several locations in the Slavonia region). Since White-tailed Eagles often feed on cadavers during the winter, secondary poisoning very likely poses a potential threat.



Fig. 9: A single tree with eagle nest was left in a clear-cut. The value of this management option for the breeding eagles has not been scientifically valuated. Photo: P. Dragicevic — Nur der Baum mit dem Seeadlerhorst wurde auf dem Kahlschlag stehen gelassen. Ob diese Maßnahme von den Adlern akzeptiert wird, wurde bisher noch nicht wissenschaftlich untersucht.

In the last couple of years, a new hazard due to the intentional poisoning of predators, particularly foxes, martens and jackals, is becoming evident in the Pannonian plain, particularly in Hungary (www.mme.hu). As the jackal population has expanded into Croatia too, there is reasonable concern that we could face the same threat very soon.

Accidental killing from collision and electrocution

– During the past decade, several eagles were carried to animal rescue centers with injuries originating from col-

lisions with electrical power lines. At the moment, the overall number of such cases is low with regard to the national population, but the threat could be potentially ranked as “medium”.

Birds in captivity

To the best of my knowledge, 13 White-tailed Eagles (9 adults, 2 immatures and 2 of unknown age) were kept in captivity in rescue centers, zoos and private collections during 2008. This number is much higher than previously reported (HELANDER & STJENBERG 2003), but also a result of much higher public sensitivity to nature and bird protection issues. Injured eagles found in nature are now usually reported to the authorities and transferred to rescue centers for treatment.

Out of 13 eagles, five individuals are in the AWAP Rescue Center for confiscated and injured protected wild animals in the town of Zaprešić, near Zagreb. Additionally, four birds were placed in the Center for confiscated and injured protected wild animals at Rušćica, Slavonski Brod; two at Osijek Zoological Gardens and two at the private Bizek Zoo near the town of Našice. Six of these birds are waiting to be released back into the wild after veterinary treatment and recovery (I. Bata, pers. comm.).

During the period 2003–2007, nine White-tailed Eagles were brought into the AWAP Rescue Center (BATA et al. 2007, BATA 2008). Out of these, two have died, three are still under veterinary treatment, three were released back into the wild and one adult (with no possibility of being released into the wild) was transferred to Palić Zoological Gardens in Serbia for the purpose of the captive breeding program (I. Bata, pers. comm.).

To my knowledge, a captive breeding program in Croatia has never been attempted.

Protection status

Legislative protection

The White-tailed Eagle is listed as ‘endangered bird species’ on the Croatian Red List under the criteria that the breeding population holds less than 120 pairs (RADOVIĆ et al. 2003, LUKAČ 2007). It is listed as ‘strictly protected species’ under the terms of Nature Protection Law (Official Gazette 70/2005 and 07/2006). The monetary penalty established by the legislation for the persecution of this species amounts to 5.350 EUR (Official Gazette 84/1996 and 70/2002).

Article 97 of the Nature Protection Law states that for a strictly protected species it is illegal

- to hunt, catch, hold in captivity or kill individuals,
- to destroy eggs and nests, take eggs from nature or possess empty eggs,
- to destroy or damage areas of reproduction or resting,
- to disturb, particularly during the reproduction period, raising of offspring, migration or hibernation, unless the disturbance would be important for protection goals,
- to conceal, possess, raise, trade, import, export, transport and steal or to acquire in any other way.

Size and duration of nest protection areas

Nests and broods of White-tailed Eagles are not safeguarded, as far as my knowledge goes, and there is no national protection plan for known nests (HELANDER & STJENBERG 2003). Other detailed protection measures are legally prescribed only in the Kopački Rit Nature Park through the “rules on behavior in the protected area” (OFFICIAL GAZETTE NO. 70/2000) where the nest protection zone, set at 500 meters and excluding ALL human activities (including forestry), is legally binding during the nesting season from 1st January until 15th July. This protection zone should be legally enforced regardless of whether the nest is occupied or not. The rationale behind this rule was that one can not predict which nest (out of several on the given eagle territory) would be occupied at the beginning of the breeding season, thus the pairs should be left undisturbed in order to sort out their territorial disputes with neighboring pairs. However, in practice, the nest protection zone is not respected by the users of the Park, particularly hunters and foresters, during the incubation period. Due to the very specific landscape features of these protected areas where floodplain forests with suitable trees for eagle nesting are distributed in a linear but narrow form (fig. 8), all major forest roads pass directly beneath the eagle nest. The unlimited year-around hunting season for Wild Boars and intensive supplemental feeding of big-game animals (particularly Red Deer *Cervus elaphus*) causes the hunters to pass by the incubating nests too often, triggering the adults to leave the nest. Recently, the establishment of hunting facilities (feeders, high towers etc.) near to the eagles nests (e.g. less than 200 meters) has also been recorded. Due to this human disturbance, nesting failures and nest abandonment are relatively high (e.g. 13 pairs terminated breeding during 2008, T. Mikuska unpubl.). To the best of my knowledge, placing artificial nest platforms has never been attempted.

In some cases, depending on the forest management office, single trees holding an eagle nest or forest patches of 100 x 100 meters are left untouched in otherwise clear-cut stands (fig. 9). The actual benefits of this practice and its impact on the breeding success have not yet been scientifically validated.

National monitoring scheme

The national monitoring of the White-tailed Eagle population in Croatia is led by the Institute of Ornithology, as a part of a National Monitoring System that is developed by the State Institute for Nature Protection. This monitoring system was developed under the obligations of the Convention of Biological Diversity (CBD) where reports on the status of national biodiversity should be periodically made. Field research and monitoring is carried out by ornithologists and rangers working in the protected areas' management offices (e.g. in Kopački Rit and Lonjsko Polje Nature Parks) or by the members of ornithological societies who cover non-protected areas.

Winter feeding

So far, a winter feeding program for White-tailed Eagles based on scientific principles has not been organized in Croatia. However, in the Kopački Rit Nature Park area (and possibly in other hunting areas, too) eagles have benefited from big game hunting because intestines were left behind the hunters (but comp. KRONE et al., this volume). However, this practice was recently outlawed and subjected to veterinary regulations and it is now illegal to dispose of dead animals and their remains (including those from farms etc.) in nature.

Further actions needed

With the extension of the White-Tailed Eagle National Monitoring Program, new data on the breeding biology and ecology could be acquired. This program should be expanded to cover all major breeding areas and to fill the gaps in the knowledge of the species' distribution. The continuation of the International Sea Eagle Color Ringing Programme should substantially benefit the existing knowledge and should be coupled with satellite telemetry projects in the near future. Due to the lack of financing, relevant studies on pollutants and poisoning are still missing. Thus, one of the priority areas should be attributed to this field of study. Feather samples, both from adults and chicks, have been collected since 2005 and are awaiting appropriate analysis.

In order to efficiently protect the Croatian breeding population, much greater efforts should be put into the legislative and practical protection against disturbance during the breeding season. This should be coupled with effective public awareness campaigns in order to increase the overall knowledge and decrease the ignorance of land users and other stakeholders. Effective protection measures both for breeding and feeding areas (e.g. maintenance of the fish production on fishponds) should be prescribed and enforced, even with financial incentives from the state budget.

Acknowledgments

I would like to thank Mr. Istvan Ham for providing comments and additional data on breeding parameters, as well as Dr. Andreja Radović, Dr. Jelena Kralj from the Institute of Ornithology, and Ms. Vlatka Dumbović Ružić from the State Institute for Nature Protection who have provided valuable and critical comments on the draft manuscript. Also, I would like to thank all persons and colleagues who accompanied me during the field work and execution of the color ringing project: Boros Annamária, Csomor Tibor, Deme Tamás, Eichner Kristina, Garai Zsolt, Lukácsi Lóránt, Kovács Sándor, Mórocz Attila, Nagy Tibor, Siklósi Máté, Sztellik Endre, Sztellik Gergely, Tell Vilmos, Tkálcevic Stjepan, Tomik Adrian and Zörényi Miklós.

The financial support for the field work in the Kopački Rit wetlands was provided by the Kopački Rit Nature Park Management Office and the Danube-Draava National Park Directorate.

Zusammenfassung

Die vorliegende Arbeit fasst die neuesten Kenntnisse über den Seeadler in Kroatien zusammen. Es werden Angaben über Verbreitung, Populationsgröße, Bruterfolg, Überwinterung, Habitatansprüche, Nahrungsbiologie, Farbberingung, Gefährdung, Vögel in Gefangenschaft und Schutzstatus der Art gemacht. Die Kroatische Population stieg stetig an und wurde im Jahr 2006 auf 135–145 Paare geschätzt. Der jährliche Bruterfolg in den Jahren 2005 und 2006 wurde auf 70,8–84,6% geschätzt. Die Intensivierung der Forstwirtschaft, Flussregulationen und Trockenlegungsprojekte, die Aufgabe von Fischteichen und Vergiftungen werden als Hauptgefährdungsursachen erachtet. Die Weiterführung und Ausweitung des nationalen Monitoringprogramms sowie Studien zu Schadstoffen werden zukünftig eine äußerst wichtige Rolle spielen.

Sažetak

U ovome radu su prikazani podaci o trenutnom poznavanju statusa orla štekavca u Hrvatskoj. Orlovi štekavci rasprostranjeni su u kontinentalnoj nizinskoj Hrvatskoj duž postojećih i nekadašnjih poplavnih dolina rijeke Dunava, Drave i Save, dok su male i izolirane populacije u mediteranskom dijelu izumrle tijekom sredine prošlog stoljeća. Nakon kritičnog perioda tijekom 70-tih godina prošlog stoljeća kada je populacija orlova štekavaca bila na najnižoj razini zbog negativnog utjecaja izazvanog upotrebom pesticida, populacija se počela povećavati krajem 80-tih i nastavila rasti sve do danas. Tijekom 2006. godine na temelju intenzivnih istraživan-

ja ona je procijenjena na 135–145 pari što predstavlja najveću populaciju od svih susjednih država u Panonskoj nizini i 1.9–2.0% procijenjene Europske populacije. Zimujuća populacija, ovisno o autorima, procijenjena je od 400+ do 501–1000 primjeraka, ali su ove procjene samo djelomično potvrđene tijekom redovitih zimskih prebrojavanja ptica močvarica.

Više od 51% gnijezdeće populacije gnijezdi u naša dva velika parka prirode – Kopačkom ritu i Lonjskom polju. Uspjeh gniježenja u posljednjih nekoliko godina na nacionalnoj razini iznosi 70.8–84.6% te se populacija trenutno smatra zdrava i održiva. Godišnji broj mladih po uspješnom gnijezdu iznosio je 1.23–1.83 u periodu 1986–1991 (podaci za cjelokupnu Hrvatsku), te 1.33–1.79 mladih po gnijezdu u periodu 2005–2008 (podaci samo za Kopački rit).

Intenzivnim istraživanjima ustanovljeno je da pola današnje populacije orla štekavaca gnijezdi unutar pojasa od 2 km od „velikih voda“ (velikih rijeka, močvara, mrtvaja ili šaranskih ribnjaka koje omogućuju odgovarajuće uvjete ishrane), a 90% gnijezdeće populacije je smješteno unutar pojasa od 4 km od „velikih voda“. Za gniježenje orlovi štekavci zahtijevaju velika i stara stabla koja mogu podržati težinu gnijezda i koja su znatno starija od postojećih sječivih zrelosti za dane vrste drveća (što osobito vrijedi za vrbe i topole).

Studije orlova štekavaca koje uključuju dodatno označavanje prstenima u boji ili krilnim markicama provedene su u dva razdoblja: od 1985–1988, te od 2005 do danas. Ukupno je na taj način označeno 134 mlada štekavca, a od 2009. godine Hrvatska učestvuje u međunarodnom programu označavanja prstenovima u boji.

Od postojećih vidova ugrožavanja ističu se intenzivno i jednodobno gospodarenje poplavnim šumama koje dovodi do fragmentacije šuma i nestanka pogodnih stabala za gniježenje, projekti regulacija rijeka i odvodnjavanja/navodnjavanja koji dovode do uništavanja staništa za ishranu orlova, napuštanje proizvodnje na šaranskim ribnjacima, uznemiravanje tijekom sezone gniježenja uzrokovano šumarskim, lovnim i rekreativnim aktivnostima, te trovanje i sekundarno trovanje olovom, drugim teškim metalima i pesticidima. Iako Zakon o zaštiti prirode propisuje određene zabrane i restrikcije vezane uz strogo zaštićene svojte, dodatne mjere zaštite su propisane odgovarajućim pravilnikom samo u parku prirode Kopački rit. Međutim, čak niti tamo se one dosljedno ne provode uzrokujući uznemiravanje tijekom gniježenja i propadanje/napuštanje legla.

Trenutno se, prema mojim saznanjima, 13 orlova štekavaca nalazi u postojećim zoološkim vrtovima, ili centrima za zbrinjavanje divljih životinja. Od ovog broja, šest jedinki će biti nakon oporavka vraćeno u prirodu.

Buduće aktivnosti u istraživanju i zaštiti orlova štekavaca u Hrvatskoj trebaju težiti proširivanju nacionalnog programa praćenja stanja (monitoringa) kako bi se pokrila sva bitna gnijezdilišta, nastavku sudjelovanja u meunarodnom programu prstenovanja u boji (uz mogućnost dodatnih projekata satelitske telemetrije), te istraživanju utjecaja teških metala i pesticida na gnijezdeću populaciju. Puno više pažnje i napora treba posvetiti aktivnoj zaštiti, osobito spriječavanju uznemiravanja tijekom inkubacije i gniježenja, kao i osiguravanju odgovarajućih mjesta za gniježenje i ishranu, uključujući uvođenje financijskih potpora za provedbu takvih aktivnosti.

References

- BATA I., PAVKOVIĆ P. & Z. HORVAT (2007): Zbrinjavanje orlova u Centru za zbrinjavanje divljih životinja (AWAP) u razdoblju od 01.01.2003. do 30.06.2007. — Downloaded from <http://www.awap.hr/>
- BATA I. (2008): I po orlovima pucajum zar ne? Još uvijek! — Downloaded from <http://www.awap.hr/awap/content/view/85/55/lang/hr/>
- BIRDLIFE INTERNATIONAL (2004): Birds in Europe: Population estimates, trends and conservation status. — BirdLife conservation series no. 12, BirdLife International, Cambridge, UK.
- BIRDLIFE INTERNATIONAL (2008): Species factsheet: *Haliaeetus albicilla*. — Downloaded from <http://www.birdlife.org> on 5/11/2008
- BRAČKO F. (1987): Belorepec, *Haliaeetus albicilla*. — *Acrocephalus* 8: 59.
- DEPOLI G. (1928): La provincial del Carnaro. — Rijeka, 124–126.
- EICHNER K. (2007): Fauna ptica baranjskog dijela Podunavlja tijekom 2006. godine. — Diplomski rad, Odjel za biologiju Sveučilišta J.J. Strossmayera u Osijeku, Osijek, 1–77.
- FRIVALDSKY J. (1891): Aves Hungariae. — Budapest, 1–197.
- GRLIĆ D. (2007): Monitoring bregunica i orla štekavca na rijeci Dravi. CD-ROM. — Prirodoslovno društvo "Drava" i Hrvatska akademija znanosti i umjetnosti, Virovitica-Zagreb.
- HAM I., MIKUSKA J. & M. SCHNEIDER (1988): Krilne markice u izučavanju disperzije mladih orlova belorepana, *Haliaeetus albicilla* (L.). Abstract Book, 4th Congress of Ecologist of Yugoslavia, Ohrid. — Savez ekoloških društava Jugoslavije: 307.
- HAM I., SAIČIĆ S. & J. MIKUSKA (1988): Mercury content in the White-tailed eagle *Haliaeetus albicilla* L. Feathers. Abstract Book, 4th Congress of Ecologist of Yugoslavia, Ohrid. — Savez ekoloških društava Jugoslavije: 456.
- HAM I., MIKUSKA J., SCHNEIDER M. & D. GEC (1990): Nalazi i promatranja prstenovanih i krilnim markicama obeleženih orlova štekavaca, *Haliaeetus albicilla*, u Jugoslaviji u godinama 1985–1988. — 1. izveštaj [Recoveries and sightings of banded and wing-tagged white-tailed eagles in Yugoslavia 1985–1988 – 1st report] — *Larus* 41/42: 69–86.
- HELANDER B. (1985): Colour-ringing of White-tailed Sea Eagles in Northern Europe. In NEWTON I. & R.D. CHANCELLOR (eds), Conservation studies on raptors. — ICBP Technical Publication No. 5, 401–407.
- HOMMONAY N. (1944a): Biológiai összefüggések a "Bellyei rét" allateletben. — *Albertina* 1: 13–33.
- HOMMONAY N. (1944b): A retisas, *Haliaeetus albicilla* és a fekete golya *Ciconia nigra* elterjedése a bellyei uradalom területén. — *Albertina* 1: 192–198.
- HORVÁTH Z. & T. PINTER (2005): Nest site selection of Hungarian White-tailed Eagles (*Haliaeetus albicilla*) according to a survey made in 2000. — *Aquila* 112: 23–32.
- KOLOMBATOVIĆ G. (1880): Osservazioni sugli uccelli della Dalmazia. — Split, 1–49.
- KOLOMBATOVIĆ G. (1896): Zoologičke vijesti iz Dalmacije [Zoological news from Dalmatia] — Split, 1–24.
- KRALJ J. (1997): Croatian ornithofauna in the last 200 years. — *Larus* 46: 1–112.
- LUKAČ G. (2007): List of Croatian birds. — *Natura Croatica* 16, suppl. 1: 1–148.
- MIKUSKA J. (1979): Seeadler (*Haliaeetus albicilla*) im Naturschutzgebiet Kopacsi-rét und in der Umgebung. — *Aquila* 85: 45–47.
- MIKUSKA J. (1980): Ugibanje ptica u upravljanoj prirodnoj rezervatu "Kopački rit". — *Larus* 31/32: 441–442.
- MIKUSKA J. (1982): The birds of prey in Yugoslavia. In MEYBURG B.U. (ed), Conference on Birds of Prey, — Thessaloniki, 1–10.
- MIKUSKA J. (1982): The importance of Kopački rit — *Aquila* 89: 205–207.
- MIKUSKA J. & J. MAJIĆ (1971/1972): Ptice Baranje [Birds of Baranja] — *Jelen* 44: 37–47.
- MIKUSKA J. & Z. MIKUSKA (1981): Zaštita orlova u Kopačkom ritu [Protection of eagles in Kopački Rit] In SPRINGER O. & H. GOMERČIĆ, Abstract book of the 1st Congress of Biologists of Croatia. — Croatian Biological Society, 170–171.
- MIKUSKA J., HAM I. & D. GEC (1989): Wing-tagging method contribution to significance of Kopački rit for population of White-tailed eagle *Haliaeetus albicilla* L. in Pannonia. Proceedings of the 3rd symposium "Modern ways of the game animal raising": 184–185.
- MOJSISOVICS A. (1886): Biologische und faunistische Beobachtungen über Vögel und Säugethiere Südungarns und Slavoniens in der Jahren 1884 und 1885. — *Mitt. Naturwiss. Ver. Steiermark* 22: 109–204.
- MÓROCZ A., MIKUSKA T. & DEME T. (2008): An international programme, or colour-ringing White-tailed eagles along the Danube. In TAMÁS E.A. (ed.), Élet a Duna-ártéren. 2007 Conference proceedings — Baja, 64–72.
- RADOVIĆ A. (2008): Characteristics and viability of the white-tailed eagle population (*Haliaeetus albicilla* L.) in Croatia. PhD thesis. — Faculty of Natural Sciences, University of Zagreb, 150.
- RADOVIĆ A. & T. MIKUSKA (2009): Population size, distribution and habitat selection of the white-tailed eagle *Haliaeetus albicilla* in the alluvial wetlands of Croatia. — *Biologia* 64: 156–164.
- RADOVIĆ D., KRALJ J., TUTIŠ V., & D. ČIKOVIĆ (2003): Red book of Endangered Birds in Croatia. — Ministry of Environmental Protection and Physical Planning, 1–179. (in Croatian)
- RUCNER D. (1954): Birds of the Neretva Valley. — *Larus* 6/7: 41–112.
- RUCNER D. (1998): Birds of Croatian Part of Adriatic. — Croatian Natural History Museum, 1–311. (in Croatian)

- RUDOLF VON ÖSTERREICH, HOMEYER E.F. & [A.] BREHM (1879): Zwölf Frühlingstage an der mittleren Donau. — *Journal für Ornithologie* **27**: 1–83.
- SPIRIĆ A., HAM I. & V. VIŠACKI (1988): Contamination of White-tailed eagle *Haliaeetus albicilla* L. eggs with organochloric pesticides and PBC's. Abstract Book, 4th Congress of Ecologist of Yugoslavia, Ohrid. — *Savez ekoloških društava Jugoslavije*, 457.
- SCHNEIDER M. (1989): Endangered and rare birds in the alluvial wetlands of the Sava river on the Posavina/Croatia. — *Larus* **40**: 167–178.
- SCHNEIDER-JACOBY M. (1996): Brutbestand des Seeadlers (*Haliaeetus albicilla*) und des Schreiadlers (*Aquila pomarina*) in den Save-Auen (Kroatien). In MEYBURG B.U. & R.D. CHANCELLOR (eds.), *Eagle Studies*. — World Working group of Birds of Prey, Berlin-London-Paris, 149–163.
- SCHNEIDER-JACOBY M. (2002): Der Donau-Save-Adria Kanal – Ein utopischer Plan verschlingt Mittel und Landschaft in Kroatien. *Euronatur Info*, Radolfzell. — *Šumarski list br.* 1–2, CXXVI: 29–34.
- SCHNEIDER-JACOBY M. (2005): The Sava and Drava floodplains: Threatened ecosystems of international importance. — *Large Rivers* **16**: 249–288.
- SCHNEIDER-JACOBY M., MOHL A. & U. SCHWARZ (2003): The white-tailed eagle in the Danube River Basin. In HELANDER B., MARQUISS M. & W. BOWERMANN (eds), *Sea Eagle 2000*. — Swedish Soc. For Nature Conservation/SSF and Atta, Stockholm, 133–140.
- ŠPOLJARIĆ N. (2000): Gnijež enje orla štekavca, *Haliaeetus albicilla*, u Kopakom ritu [Breeding of white-tailed eagles in Kopački Rit] — Diplomski rad, Pedagoški fakultet Sveučilišta JJ Strossmajera u Osijeku, 1–25.
- WASHINGTON S. (1885): Ornithologische Notizen aus Istrien. — *Zeit. Ges. Ornithol.* **2**: 341–367.

Author's address:

Tibor MIKUSKA
Croatian Society for the Protection
of Birds and Nature
Gundulićeva 19a, HR-31000 Osijek, Croatia
E-mail: tibor.kopacki.rit@gmail.com